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# *Achievements during the 90's of Chile's ICT in Education Program: an International Perspective*

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## *Abstract*

This paper presents the main results of a national survey of the Chilean educational ICT infrastructure and its implementation in schools, and it puts these results in an international perspective. The survey was carried out in 1999 and its design followed the guidelines of the international SITES M1 study, sponsored by the IEA. In general terms, the results presented in this report place Chile in quite a good position in the international ranking with respect to several indicators related to ICT in education, especially in teacher training. Moreover, on many indicators Chile's results are similar or even better than the ones shown by developed countries such as Japan, Italy and France. Also, they show some challenges related to the provision of infrastructure (hardware) and ICT resources (software), particularly in primary education. Finally, they show opportunities for deepening further the instructional use of ICT in schools.

## *Keywords*

ICT in education, Chilean educational reform, national policy, international indicators.

## 1. *Introduction*

Since the early 1990's, Chile has been implementing an educational reform to upgrade the quality of and the equality in Chilean education. The main components of this reform are: comprehensive investment and support programs which combine more resources with new teaching and learning methodologies; specific programs for the poorer schools; a new, more ambitious and contemporary curriculum aimed at developing higher-order thinking skills; an extended school day for the whole student population; and better salaries and working conditions for teachers. In terms of national policies, education has been the nation's top priority during the last decade (García-Huidobro, 1999).

In this context, *Enlaces* (links) is the information and communications technology (ICT) initiative of this reform since 1992. Its aim is to integrate these technologies as learning and teaching resources for all students and teachers in the ten thousand Chilean state schools[i]. By the year 2002, 75% of primary and 100% of secondary schools participated in *Enlaces*, covering 95% of the student population. Each of these schools received computers; local networks; educational and productivity software and most of them have free and unlimited Internet access to specially created educational content relevant to the Chilean curriculum. Also, the Ministry of Education, in partnership with 24 universities all over the country, provides long-term technical and pedagogical support to each school, with more than 70% of teachers already trained in the basic use of ICT (see: http://www.redenlaces.cl/; Hepp, 1998; Laval & Hinostroza, 2002; Potashnik, 1996).

Within this framework, this report presents the main results of a national survey of the Chilean educational ICT infrastructure and its implementation in schools, as well as the international results of these indicators. The survey was designed and implemented according to the international study SITES M1 (IEA, 1998) and the data from other countries was extracted from the report by Pelgrum & Anderson, (1999).

The report is organized to first of all present the results of the services that *Enlaces* provides to schools (Hardware, Internet, Software and Training) and then it presents results showing the consequences of these services in the schools. In synthesis, it gives an overview of the achievements of *Enlaces* over almost a decade of implementation, and does so in the context of data on the same indicators from twenty six other countries, which provides an adequate frame of reference for analysing such achievements.

## 2. *Methodology*

The study was designed as a survey, following the international guidelines and procedures described by Pelgrum & Anderson, (1999). The study in Chile was carried out during 1999. The general procedure considered the following activities: translation and validation of the instruments, sample size estimation and selection, administration of the survey instruments, transcription of data, database clean-up, and descriptive statistical analysis.

## 2.1 Sample

The sample was stratified and proportional with a 95% confidence level. It was representative of the student population and schools that were part of the *Enlaces* project up to 1999[ii]. Stratification variables were: student population of the school, with three size categories, and grade level range of the school (primary or secondary)[iii]. Within the strata, schools were randomly selected. The following table presents the schools considered for the study and the sample selected.

**Table 1. Total and sample schools considered in the study**

| | Primary | Secondary | Total |
|---|---|---|---|
| **Universe considered** | 2.861 | 1.154 | **4.015** |
| **Sample used** | 312 | 134 | **446** |
| **Percentage of schools** | **11%** | **12%** | **11%** |

## 2.2 Data collection

The data collection consisted of the administration of two questionnaires: one for the Computer Lab coordinator and one for the principal of the schools. Questionnaires were sent by post and returned by the respondents. Therefore, results presented here correspond to the computer lab coordinator's perceptions and/or those of each school's principal.

## 2.3 Analysis

After the process of database clean up, and in order to be able to represent the student population as well as all the schools, two procedures were carried out. Firstly the data was adjusted using an expansion factor based on the sample stratification in order to represent the schools in the system. For those results that represent the student population, a correction factor based on the student population of each school was used in order to assign the adequate weight to each school.

The data was then pooled and graphed alongside similar data from 26 other countries, extracted from the Pelgrum & Anderson, (1999) study. However, it must be kept in mind that, because of methodological limitations related to sampling issues, these results are used for observing the main tendencies on each domain of achievement. The countries considered were the ones that participated in the SITES M1study, namely:

1. Belgium-French
2. Bulgaria
3. Canada
4. China Hong Kong
5. China Taipei
6. Cyprus
7. Denmark
8. Slovenia
9. Russian Federation
10. Finland
11. France
12. Hungary
13. Iceland
14. Israel
15. Italy
16. Japan
17. Latvia
18. Lithuania
19. Luxemburg
20. Norway
21. New Zealand
22. Czech Republic
23. Slovak Republic
24. Singapore
25. South Africa
26. Thailand

# *3. Results*

## 3.1 Infrastructure

This section presents the results of the study regarding the availability of ICT infrastructure (Hardware, Software and Internet) at each school.

### 3.1.1 Hardware

One goal of *Enlaces* is to provide hardware to schools. The equipment –which is purchased through a public bidding process according to annually updated technical standards– includes multimedia computers, printers, modems and a local area network. These are allocated according to the number of students in each school. The following table shows the current availability of computers in schools.

**Table 2. Average number of computers available at each school level, according to source**

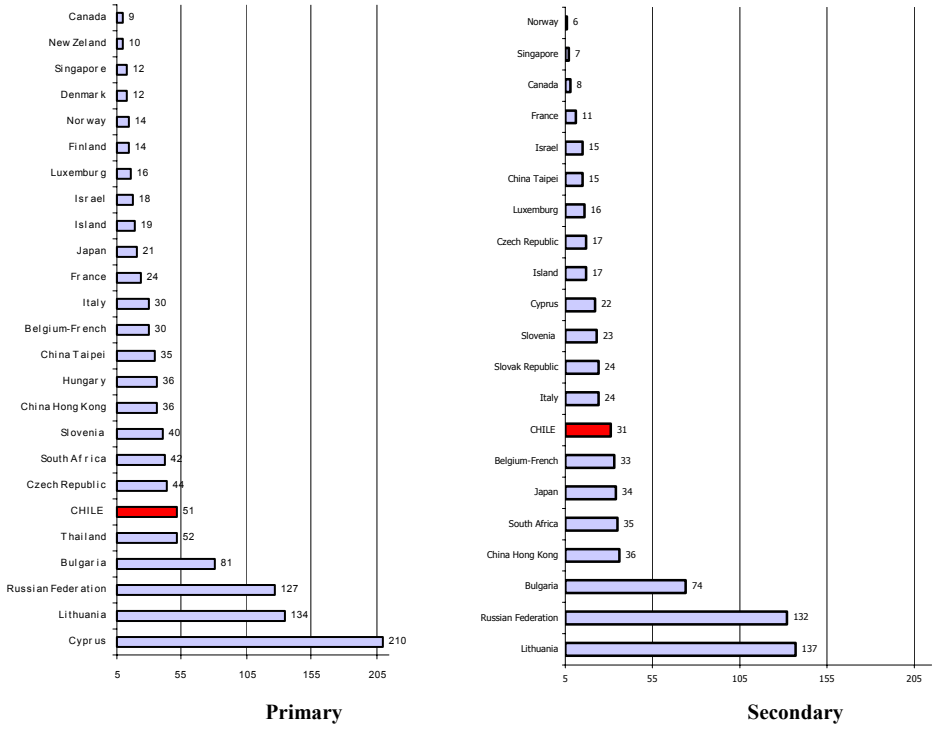
| Type of school | Computers provided by Enlaces | Total number of computers in the school | % of additional computers |
|---|---|---|---|
| Primary | 6,7 | 8,9 | 25% |
| Secondary | 10,1 | 22,4 | 55% |
| **All schools** | **7,7** | **13,1** | **41%** |

These results show that schools increased the number of computers available, particularly in secondary education where they doubled the number of computers provided by the state. The economic effort made by the schools is taken as an indication of the value that schools and the community give to ICT.

### 3.1.2 Student – Computer ratio

The number of students per computer is a common international indicator for assessing the availability of computers in the educational system. Considering all the computers available and the student population in each school, this ratio in Chile is 51 students per computer for primary schools, and 31 for secondary schools. The next graph shows the international results of these indicators.

**Graph 1. International results of student-computer ratio for primary and secondary education**



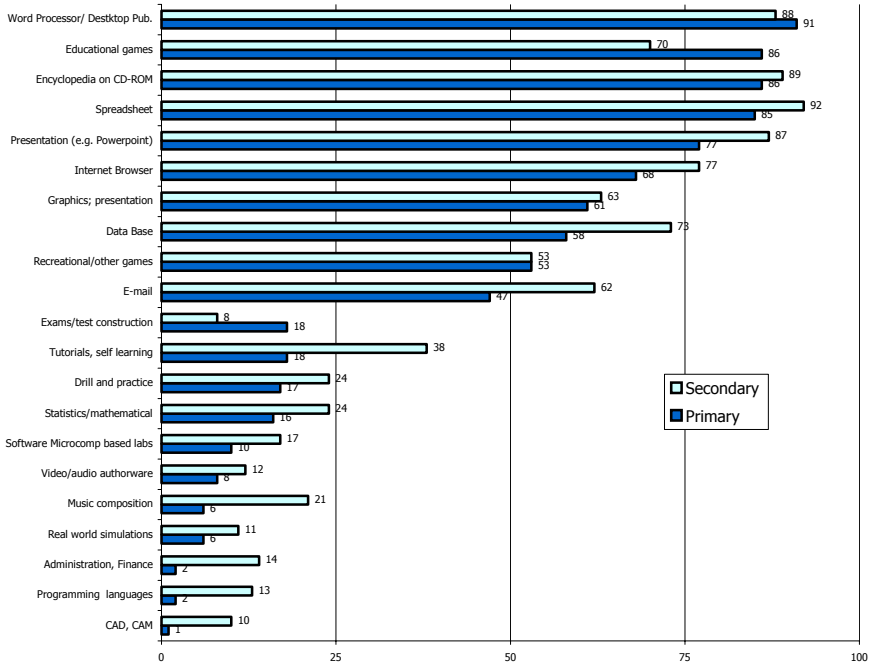

These graphs show the position of Chile in this indicator compared to other countries participating in the study. It can be seen that Chilean schools belong to a group of

schools that have an intermediate ratio of students per computer (between 30 and 50), yet far behind developed countries, which have ratios in the range of 10 students per computer. However, in secondary education Chile's ratio is better than the ones for countries like Japan, Belgium and France. Based on these results it is possible to recognise that, even though there is still a need to increase the number of computers available at schools, Chile has made a significant effort in this field.

### 3.1.3 Software

Another goal of *Enlaces* has been to equip schools with adequate software in order to support their study programs. The range of software includes standard productivity applications such as word processing, spreadsheets and graphics programs, along with educational software on topics such as biology, space, science, math, geometry, scientific experimentation, Chilean history, world history, geography, literature, music, art, physics, chemistry, the environment, etc. The next graph shows the availability of software in primary and secondary schools in Chile.

**Graph 2. Percentage of students whose schools possessed particular types of software for educational use at the two levels**

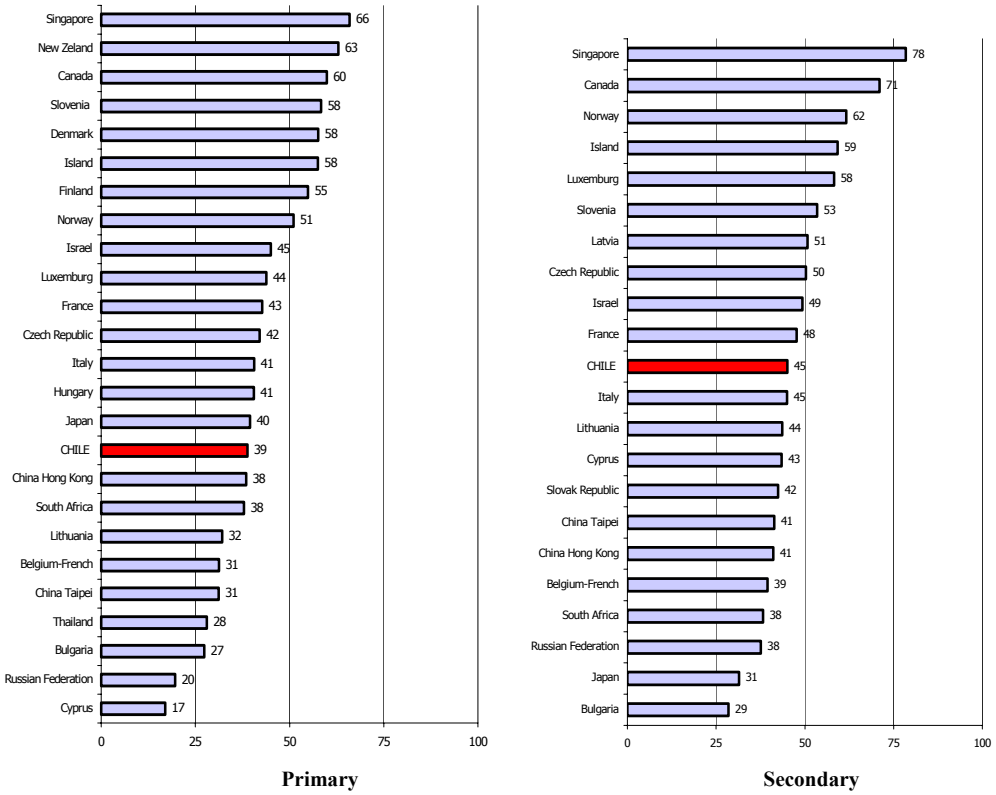



This graph shows that the majority of students attend schools where software such as word processors, encyclopedias on CD-ROM, spreadsheet and presentation software is available. It also shows that most primary education students go to schools where they can find educational games, and that most secondary education students attend schools where they can find Internet browsers, e-mail and data-base software.

On the one hand, these results reflect the effectiveness of the Chilean ICT resource provision policy described above, and on the other hand, they show that there is a lack of more specialised (or advanced) educational software such as simulators, science and math tutorials, etc.

In order to compare the availability of software among countries, Pelgrum & Anderson, (1999) elaborated an indicator based on the calculation of the average of percentages shown in graph 2. The international results of this indicator are presented in the following graphs.

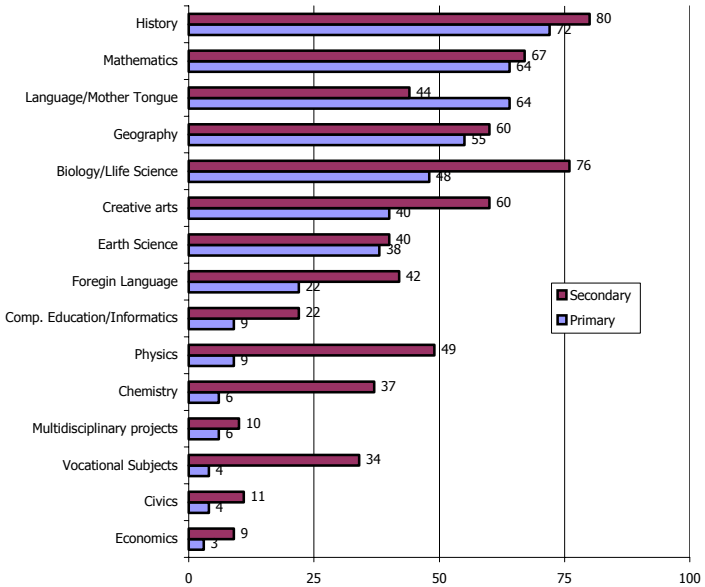
**Graph 3. International indicators of software availability in primary and secondary education**




These graphs show that in Chilean primary education, availability of software is relatively low compared to countries like Canada or Singapore and similar to the availability found in Japanese schools. In secondary education the Chilean results are better, and are similar to those of countries like Italy and France.

The next graph presents a more detailed account of the school subjects covered by this software.

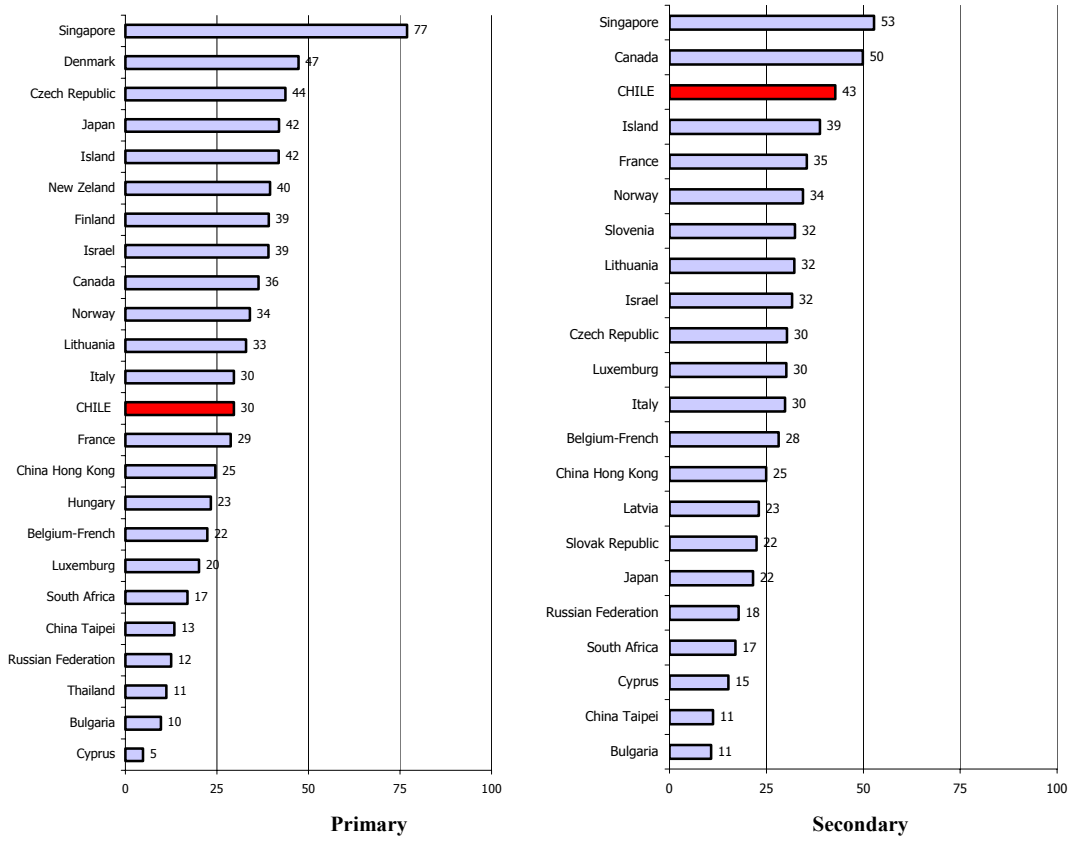
**Graph 4. Percentage of students whose schools had content-specific software for school subjects in primary and secondary education**



This graph shows that the subjects most frequently covered by the software that is available to primary school students in schools are ***history*** and ***mathematics***; software for ***languages*** is also common. And in secondary schools ***biology*** and ***geography*** are covered most. Although the resource provision policy for primary and secondary education was similar, it can be appreciated that software in secondary schools covers a larger variety of subjects.

In order to compare the availability of software for school subjects in different countries, in the study they elaborated an indicator based on the average of the percentages shown in graph 4. The international results for this indicator are presented in the following graph.

**Graph 5. International results of the indicator of software availability for school subjects in primary and secondary education**



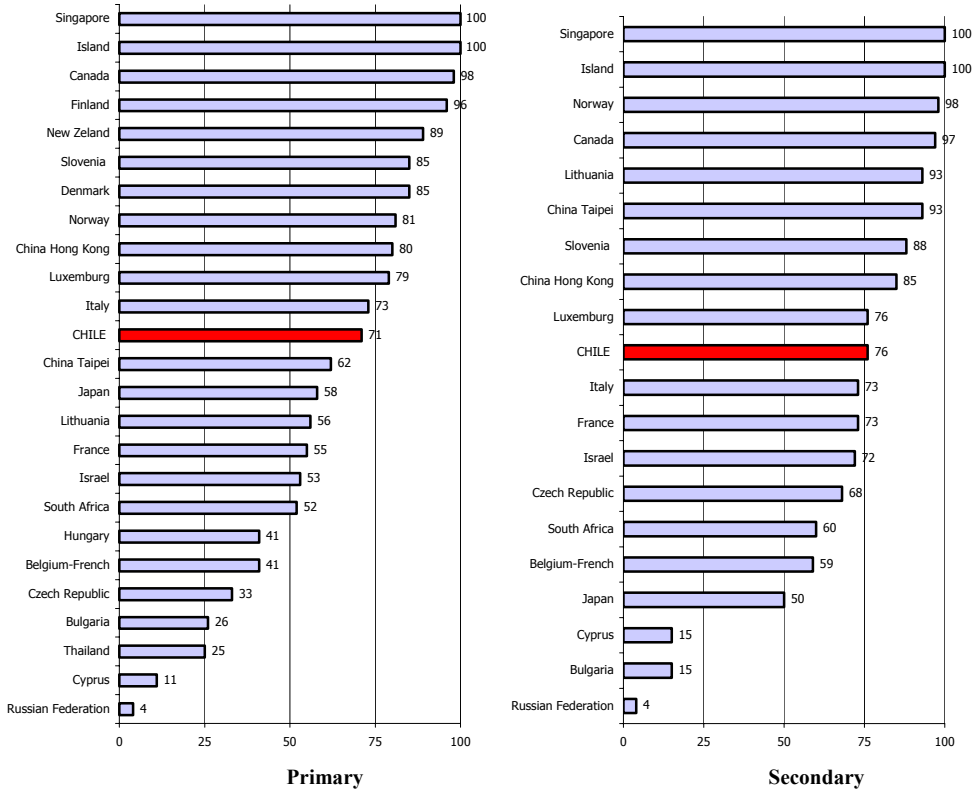

Using this indicator in primary education, Chile appears in the middle range of the array of countries. Whereas in secondary education, Chile's is in third place overall, closer to countries like Singapore and Canada. This last result is important since the use of ICT was defined as a transversal aim in the new curriculum for Chilean secondary schools, indicating thereby that it should be used in all the core subjects (Language, Math, Science, etc.) and not as a separate subject by itself.

### 3.1.4 Internet

The concept of building a network of schools was embedded in the early design of *Enlaces* (see: Hepp et al., 1994); therefore the provision of Internet connection and digital resources is at the core of the program. One of the main achievements in this area was the donation of free unlimited access to Internet made by a private

telecommunications company. The following graph shows the percentage of students that attend schools that have an Internet connection available for educational use.

**Graph 6. Percent students whose schools declared having an Internet connection for educational use**

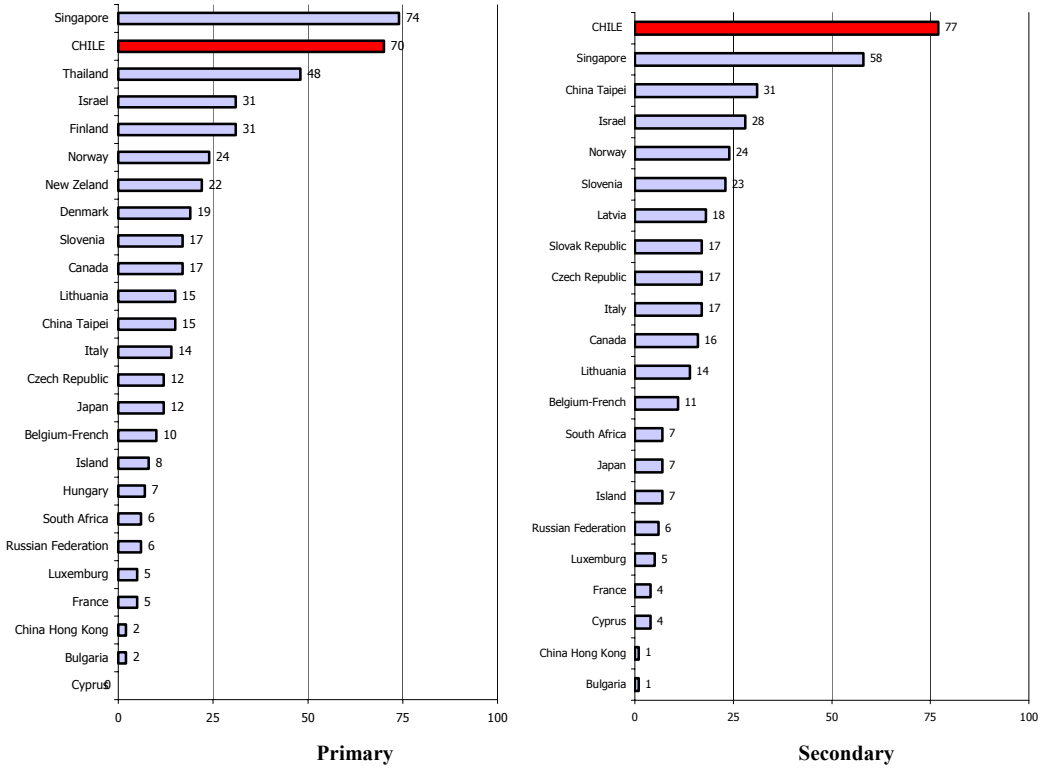



These graphs show that, although Chile is in an intermediate position overall, Internet access is high. In fact, Chilean students' access to Internet is similar to that of students from Japan and Italy.

## 3.2 Teacher Training

Another aim of *Enlaces* was to provide training and support to teachers in schools. In fact, it provides two years of training to twenty teachers per school (see: Rehbein, Labbé & Campos, 2003). The following graphs show the international results of the partial or full realisation of the aim of training all school teachers in the general use of ICT.

**Graph 7. Percent of students whose school principals declared they have trained all (or almost all) teachers in the general use of ICT in primary and secondary education**




These graphs show that Chile is at the top of the list with regard to teacher training in the general use of ICT in education, only Singapore has a better result in primary education. These results reflect the successful implementation of *Enlaces'* training strategy in terms of coverage.

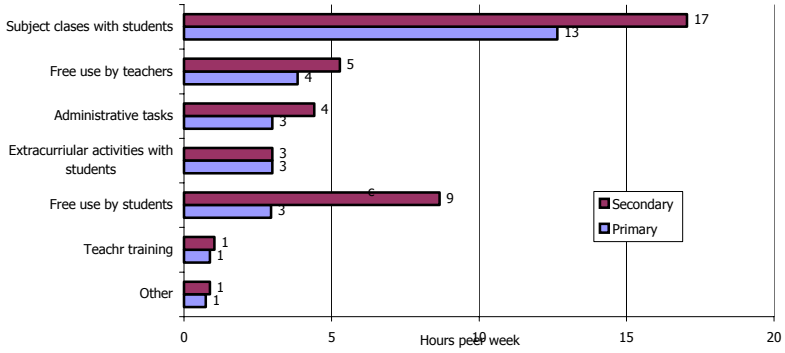
## 3.3 ICT uses

The following sections present results that illustrate several dimensions of the ways in which schools are using their ICT resources, thus far. Although these results could be considered the "consequences" of the actions taken by *Enlaces*, it should be kept in mind that *Enlaces* is part of the larger effort implemented by the Chilean educational reform.

### 3.3.1 Time of use

One of the expected outcomes of the project is that the resources provided are actually used in the schools. The following graph shows the time spent on different activities in the computer lab.

**Graph 8. Average number of hours per week the computer lab is used in primary and secondary schools**

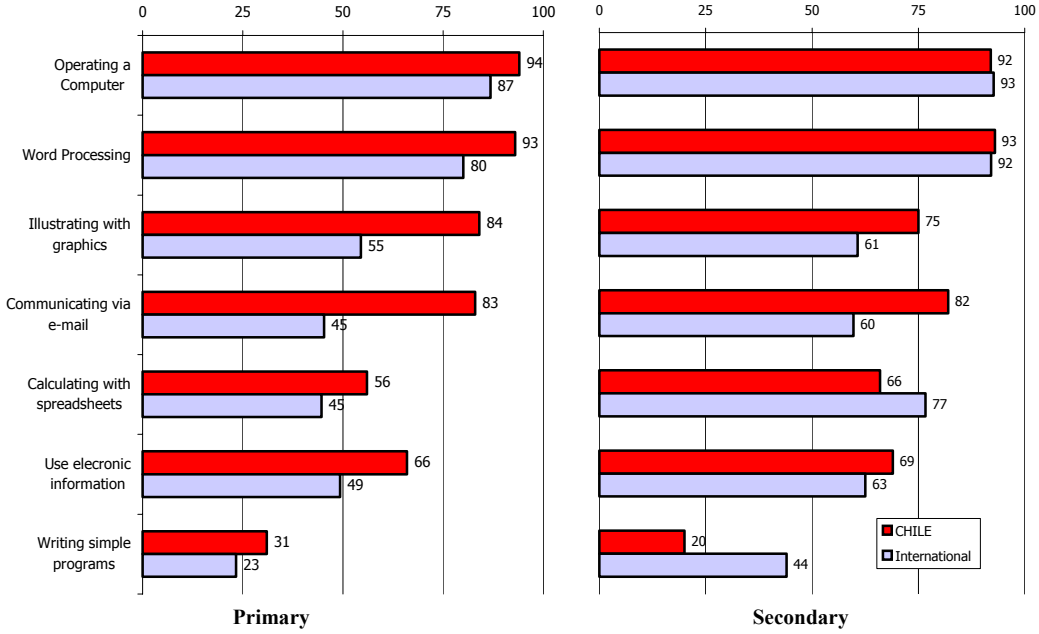



This graph shows that the computer lab is used more in secondary education (40 hours a week) than in primary education (28 hours a week). Added together all the activities carried out by students, they represent 70% of the time the lab is used.

### 3.3.2 Students ICT Skills

The importance of students acquiring ICT skills has been recognized internationally (OECD, 2001) and it is also part of *Enlaces'* agenda. The following graph shows the ICT related skills that Chilean students would acquire by the end of the grade level and the international average for these results.

**Graph 9. Percentage of students whose school principals indicated that students would acquire particular ICT-related skills by the end of primary and secondary education respectively**

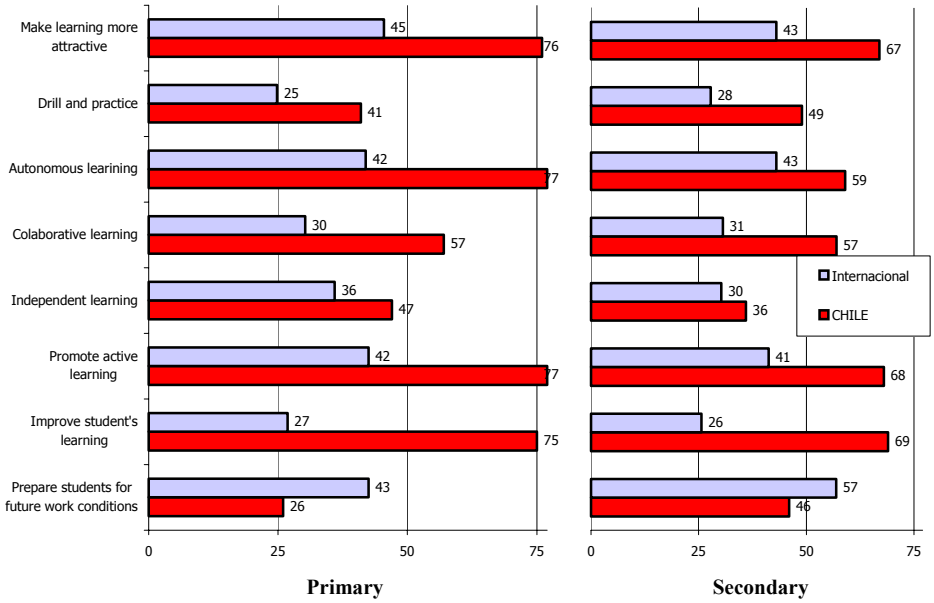



These graphs show that most of the Chilean students would acquire skills for operating a computer and word processing, illustrating with graphics, and communicating by e-mail. In primary education, Chilean results are above the international average, especially with regard to e-mail communication and similar results are seen in secondary education. The only exceptions that are below the international average are the use of spreadsheets and writing simple programs. Chile's results regarding the use of e-mail are probably a consequence of the initial design of *Enlaces*, where electronic communication was one of the first tools used by teachers (see Hinostroza, Laval, Hepp, Iost, & Rivera, 1995).

## 3.4 Goals and Aims regarding ICT at schools

The following graphs show the goals of use of ICT declared as very important by the schools' principals.

**Graph 10. Percentage of students whose school principals indicated certain aims as very important in defining the goals of use of ICT in primary and secondary education**



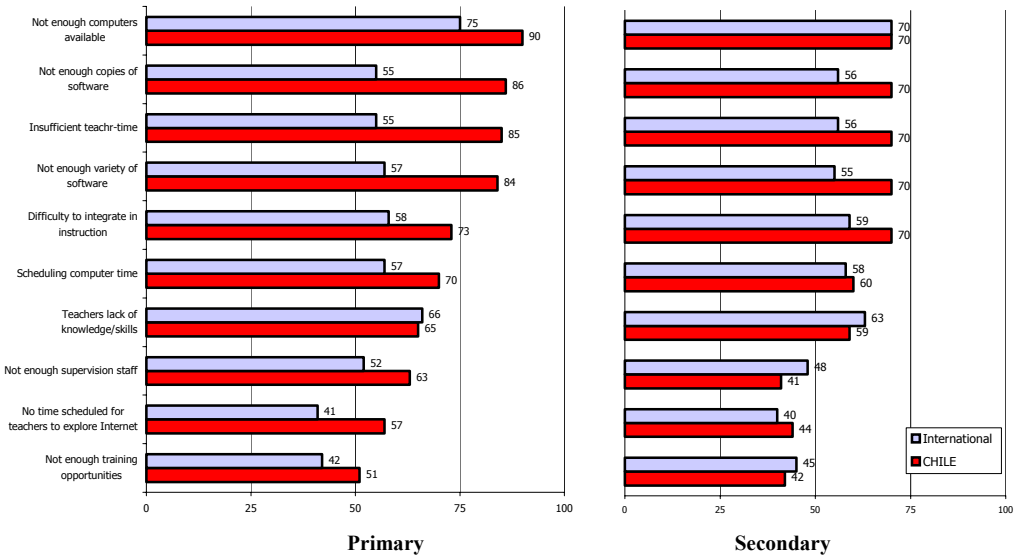

These graphs show that in Chile the use of ICT is considered relevant for goals such as making learning more attractive, promoting autonomous, collaborative and active learning and improving students' learning. These results are largely above the international average. On the other hand, the relevance of preparing students for future jobs is very much below the international average.

These results indicate that principals associate the use of ICT to the implementation of teaching and learning methods that are also promoted by the Chilean educational reform. Therefore it can be argued that ICT is perceived as useful for implementing new methodologies. This result is significant since some of the factors recognised in the literature as relevant for the use of ICT in the schools, are the principal's perception of usefulness of ICT (Fullan, 1998; Fullan, 1996) as well as his/her openness to change (Baylor & Ritchie, 2002).

## 3.5 Obstacles to ICT implementation

Finally, the following graph shows the ten most frequent obstacles mentioned by the schools' principals.

**Graph 11. Percentage of students whose school's principal indicated certain major obstacles for ICT implementation in primary and secondary education**




These graphs show that the most frequent obstacles are related to infrastructure (hardware, number of copies and variety of software), to teachers' time and to the integration of ICT into instruction. These ten obstacles found in Chile are also those found most frequently in other countries.

## *4. Discussion*

In general terms, the results presented in this report place Chile in quite a good position in the international ranking of several indicators related to ICT in education, especially with respect to teacher training. Moreover, for many indicators, Chile's results are similar or even better than the ones shown by developed countries such as Japan, Italy and France. Also, they indicate some challenges ahead, particularly related to the provision of infrastructure (particularly hardware) and the improvement of ICT resources in primary education (software).

Regarding the services provided by *Enlaces*, the study shows that the Chilean ICT policy, together with private sectors' initiatives (telecommunication industry) were able to install an internationally competitive infrastructure in Chilean schools (hardware, software and Internet). Also, it shows that this infrastructure is extensively used during the week (time). Finally, it shows the widespread implementation of teacher training in the general use of ICT. This last result is very significant; since it implies that there is a capacity for using ICT in the educational system and therefore there are promising opportunities to develop further the use of ICT in schools.

Looking at some of the results related to the "consequences" of the educational policy, the study shows that, in Chile, the aims for the use of ICT reported by the school principals are related to the implementation of active, collaborative and autonomous learning. However, the obstacles mentioned by the school principals include the difficulty in integrating ICT into instruction as well as a lack of teachers' knowledge to do this. These results show that schools' principals are aware of the opportunity to use ICT as an aid for implementing new teaching and learning methods proposed in the

educational reform and that they recognise the obstacles to doing so. Given this scenario, one of the biggest challenges that *Enlaces* will face in the coming years is to provide answers to these questions.

## *5. References*


Baylor, A. L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? *Computers & Education, 32*, 395-414.

Fullan, M. (1998). The meaning of educational change: A quarter of a century of learning. In Hargreaves, A.; Lieberman, A.; Fullan, M. & Hopkins, D. (Eds.), *International Handbook of Educational Change* (pp. 214-228). London: Kluwer Academic Publishers.

Fullan, M. G. (1996). Implementation of Innovation. In Plomp, T. & Ely, D. E. (Eds.). International Encyclopedia of Educational Technology (pp. 273-281). Oxford: Elsevier Science - Pelgrum.

García-Huidobro, J. E. (Ed.). (1999). *La reforma educacional Chilena*. Madrid: Editorial Popular.

Hepp, P. (1998). Chilean experiences in computer education systems. In de Moura Castro, C. (Ed.). *Education in the Information Age* (pp. 116-130). New York: Inter-American Development Bank.

Hepp, P., Rehbein, L., Hinostroza, E., Laval, E., Dreves, C., & Ripoll, M. (1994). Enlaces' A hypermedia based educational network. Paper presented at the *ACM Multimedia: The Second International Conference on Multimedia*, San Francisco, California, USA.

Hinostroza, E., Laval, E., Hepp, P., Iost, H., & Rivera, R. (1995). Human Computer Interface for Educational Software: An Electronic Communications Software Implementation. Paper presented at the *World Conference on Computers in Education VI: WCCE'95 Liberating the Learner*, Birgminham.

IEA. (1998). Module 1 Indicators Module. Second Information Technology in Education Study. International Association for the Evaluation of Educational Achievement. Retrieved, 2002, from the World Wide Web: http://sitesm2.org/SITES_Research_Projects/sitesm1.html

Laval, E., & Hinostroza, E. (2002). Chilean Schools: The Enlaces Network. *TechKnowLogia,* 4(3).

OECD. (2001). *Learning to Change: ICT in Schools*. Paris: OECD.

Pelgrum, W. J., & Anderson, R. (1999). *ICT and the emerging paradigm for life long learning: A worldwide educational assessment of infrastructure, goals and practices*.

Amsterdam: International Association for the Evaluation of Educational Achievement. University of Twente OCTO.

Potashnik, M. (1996). Chile's learning network. In *Education and Technology Series Vol. 1* 2. Washington, D.C.: The World Bank.

Rehbein, L., Labbé, C., & Campos, M. (2003) Enlaces' In-service Teacher Training Goals and Strategies: A Review of Critical Features. *Interactive Educational Multimedia*, 6, (this issue).

[i] 90% of the Chilean student population attends state schools.

[ii] In 1999, there were 4.255 schools in Enlaces that covered 70% of the Chilean subsidised student population.

[iii] The international study identified three populations: primary, lower secondary and upper secondary. In Chile the first two populations attend the same school, therefore the instruments were modified so as to include both populations in one questionnaire, but where required, asking for each population independently.